II. REMARKS

The Examiner has withdrawn, in part, the restriction/election requirement under 37 U.S.C §§ 121 and 372 so that the following claims, i.e., Groups I (claims 1, 5-10, 16, 21, 22, 26, 29, 30, 35 and 36), have been examined, and only claims 2-4, 11-15, 17-20, 23-25, 27-28 and 31-34 except claims 1, 5-10, 16, 21, 22, 26, 29, 30, 35 and 36 as elected above, have been withdrawn because they pertain to non-elected invention (Office Action, dated October 16, 2009, at p. 2, lines 9-14). Therefore, claims 1, 5-10, 16, 21, 22, 26, 29, 30, 35 and 36 have been examined.

With the above amendments, claims 1, 5, 6 and 16 have been amended.

For example, claim 1 has been amended to recite "wherein grains of the copper-based alloy casting are refined during melt-solidification" as supported on p. 5, paragraph [0018] of Applicant's original disclosure. Claim 1 has been also amended to improve clarity. Claims 5, 6 and 16 have been amended to recite the proper language for Markush group, i.e., "at least one element selected from the group consisting of ...."

The present amendment adds no new matter to the above-captioned application.

A. The Invention

The present invention relates broadly to a copper-based alloy casting in which grains are refined after melt-solidification, and particularly, to a Cu--Zn--Si alloy casting.

In accordance with an embodiment of the present invention, a copper-based alloy casting is provided that includes elements recited in independent claim 1.

Various other embodiments, in accordance with the present invention, are recited in the dependent claims.

An advantage provided by the various embodiments of the present invention is that a copper-based alloy casting without casting defect can be provided if grains are refined during melt-solidification of the copper-based alloy.

B. The Rejections

Claims 5, 6 and 16 stand rejected under 35 U.S.C. § 112, second paragraph, as allegedly indefinite.

Claims 1, 5, 7-10, 21, 29 and 35 stand rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over U.S. Patent No. 4,110,132 to Parikh et al. (hereafter "Parikh '132").

Claims 6, 16, 22 and 30 stand rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Parikh '132 as appled to claims above, and further in view of U.S. Patent No. 4,826,736 to Nakamura et al. (hereafter "Nakamura '736").

Applicant respectfully traverses the Examiner's rejections and requests reconsideration of the above-captioned application for the following reasons.

C. Applicants' Arguments

1. The Section 35 U.S.C. § 112, Second Paragraph Rejections

For a claim to comply with 35 U.S.C. § 112, second paragraph, it must (1) set forth what the Applicant regards as the invention and (2) it must do so with sufficient particularity and distinctness so as to be sufficiently "definite." Solomon v. Kimberly-Clark Corp., 55 U.S.P.Q.2d 1279, 1282 (Fed. Cir. 2000). During patent prosecution, definiteness of a claim may be analyzed by consideration of evidence beyond the patent specification, including the inventor's statements to the Patent and Trademark Office. Id.

In view of the present amendment, claims 5, 6 and 16 are in compliance with 35 U.S.C. § 112, second paragraph, for the following reasons.

Claims 5, 6 and 16 have been amended to recite the proper language of Markush group, "at least one element selected from the group consisting of . . . ."

For all of the above reasons, claims 5, 6 and 16 particularly point out and distinctly claim the invention in compliance with 35 U.S.C. § 112, second paragraph.

2. The Section 103 Rejections

A prima facie case of obviousness requires a showing that the scope and content of the prior art teaches each and every element of the claimed invention, and that the prior art provides some teaching, suggestion or motivation, or other legitimate reason, for combining the references in the manner claimed. KSR International Co. v. Teleflex Inc., 127 S.Ct. 1727, 1739-41 (2007); In re Oetiker, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992).

In this case, the Examiner has failed to establish a prima facie case of obviousness against claims 1, 5-10, 16, 21, 22, 26, 29, 35 and 36, because neither Parikh '132 nor Nakamura '736, alone or in combination, teaches, or suggests, all the limitations of the claims.

For example, neither Parikh '132 nor Nakamura '736, alone or in combination, shows or suggest the limitation of "wherein grains of the copper-based alloy casting are refined during melt-solidification, and mean grain size of the refined grains after the melt-solidification is 100 μm or less, and wherein α, κ and γ-phases of the copper-based alloy casting occupy more than 80% of phase structure of the copper-based alloy casting" as recited in independent claim 1.

The combination is also improper because (1) the Examiner has failed to establish a legitimate reason to make the combination and (2) the Examiner has failed to demonstrate

that a person of ordinary skill in the art would have had a reasonable expectation of success of arriving at Applicant's claimed invention if the combination were made. Thus, the rejections under § 103 should be reconsidered and withdrawn.

i. The Section 103 Rejections against claims 1, 5, 7-10, 21, 29 and 35 over Parikh '132

Parikh '132 fails to establish a prima facie case of obviousness against claims 1, 5, 7-10, 21, 26, 29, 35 and 36 for the following reasons.

(a). Parikh '132

Parikh '132 relates to copper base alloys with improved combination of strength and bend properties, while retaining low stacking fault energy (Parikh '132, col. 1, lines 13-16).

A copper base alloys of Parikh '132, comprises a first element selected from the group consisting of about 2 to 12% aluminum, preferably 2 to 10% aluminum, about 2 to 6% germanium, preferably 3 to 5% germanium, about 2 to 10% gallium, preferably 3 to 8% gallium, about 3 to 12% indium, preferably 4 to 10% indium, about 1 to 5% silicon, preferably 1.5 to 4% silicon, about 4 to 12% tin, preferably 4 to 10% tin, and about 8 to 37% zinc, preferably 15 to 37% zinc, and at least one second element different from the first element, the second element being selected from the group consisting of about 0.001 to 10% aluminum, preferably 0.01 to 4% aluminum, about 0.001 to 4% germanium, preferably 0.01 to 3% germanium, about 0.001 to 8% gallium, preferably 0.01 to 7% gallium, about 0.001 to 10% indium, preferably about 0.01 to 9% indium, about 0.001 to 4% silicon, preferably about 0.01 to 3.5% silicon, about 0.001 to 10% tin, preferably about 0.01 to 8% tin, about 0.001 to 37% zinc, preferably about 0.01 to 35% zinc, about 0.001 to 25% nickel, preferably about 0.01 to 20% nickel, about 0.001 to 0.4% phosphorus, preferably about 0.01 to 35%

phosphorus, about 0.001 to 5% iron, preferably about 0.01 to 3.5% iron, about 0.001 to 5% cobalt, preferably about 0.01 to 2% cobalt, about 0.001 to 5% zirconium, preferably about 0.01 to 3.5% zirconium, about 0.001 to 10% manganese, preferably about 0.01 to 8.5% manganese and mixtures (Parikh '132, col. 2, line 61 to col. 3, line 24).

As admitted by the Examiner (Office Action, dated October 16, 2009, at p. 3, lines 9-10), Parikh '132 does not teach, or suggest, (i) "wherein α, κ and γ-phases of the copper-based alloy casting occupy more than 80% of phase structure of the copper-based alloy casting" as recited in claim 1, (ii) "wherein P/Zr is in the range of 0.8 to 250, Si/Zr is in the range of 80 to 6000, and Si/P is in the range of 12 to 220" as recited in claims 7 and 21, and (iii) "wherein dendrites are crystallized, and the dendrites have shapes with no arms" as recited in claims 8 and 26.

However, these are the only deficiencies in the disclosure of Parikh '132. Parikh '132 does not teach, or suggest, (iv) "wherein grains of the copper-based alloy casting are refined during melt-solidification, and mean grain size of the refined grains after the melt-solidification is 100 μm or less" as recited in claim 1.

With respect to the above deficiencies, the Examiner contends that since instant Cu-Zn alloy is formed by casting, said properties would have been **inherently** possessed by cast alloys, i.e., copper base alloys of Parikh '132 (p. 3, lines 10-16 of this Office action). Applicant objects to the Examiner's inherency argument.

The Federal Circuit has held that a reference may inherently teach subject matter not explicitly disclosed by the reference when the disclosure is sufficient to show that the implicit subject matter is the natural result flowing from the explicitly disclosed subject matter. Continental Can Co. USA Inc. v. Monsanto Co., 20 U.S.P.Q.2d 1746, 1749 (Fed. Cir. 1991). However, inherency cannot be established by mere probabilities or possibilities, and the mere fact that a certain thing may result from a given set of circumstances is insufficient. Id. The

Federal Circuit has ruled that inherency is a question of fact. In re Napier, 34 U.S.P.Q.2d 1782, 1784 (Fed. Cir. 1995). The Examiner's naked speculation falls far short of establishing that the copper base alloy composition of Parikh '132 naturally possesses the specific phase configurations, ratios of elements, and dendrite shapes without arms, as claimed.

According to a preferred embodiment of the present invention, a copper-based alloy casting is provided, wherein grains of the copper-based alloy casting are refined during melt-solidification of casting process, and mean grain size of the refined grains of the copper-based alloy casting is 100 μm or less after the melt-solidification of the casting process, as claimed (Applicant's original disclosure, p. 5, paragraph [0018]).

In contrast, Parikh '132 discloses a process for obtaining copper base alloys, which is characterized by a critical combination of cold reduction and annealing following recrystallization. Specifically, a copper base alloy Parikh '132 is cast and hot-rolled, and then is fully recrystallized in order to obtain fine grains of less than 0.015mm. Hot-rolling step is performed to break up the cast structure of the copper base alloy. The hot-rolled alloy is subjected to recraystallization, subsequently, cold reduction and annealing (Parikh '132, Abstract and col. 3, line 35 to col. 5, line 12). In fact, the copper base alloy having fine grain size of less than 0.015mm in Parikh '132 is the fully recrystallized material obtained after recrystallization following casting and hot-rolling, not the cast material formed after melt-solidification of casting as claimed.

Furthermore, Parikh '132 teaches away from the claimed invention. Casting process of the present invention, i.e., melt-solidification, is important to provide a copper based alloy having refined grains of 100 μm or less, as claimed, whereas casting and hot rolling steps in a copper base alloy of Parikh '132, preformed before recrystallization step, are not particularly critical, thus, the alloy may be cast in any desired or convenient manner and hot rolled as desired to break up the cast structure (Parikh '132, col. 3, lines 35-41).

For these reasons, Parikh '132 does not disclose "wherein grains of the copper-based alloy casting are refined during melt-solidification, and mean grain size of the refined grains after the melt-solidification is 100 μm or less" in claim 1.

In the phase structure of the copper-based alloy casting of the present invention, α, κ and γ-phases are adjusted to occupy 80% or more of the structure. Such specific phase structure is required to reduce the mean grain size of the refined grains after melt-solidification of casting process to be about 100 μm or less (Applicant's original disclosure, p. 5, paragraphs [0079] and [0080]). Also, in the copper-based alloy casting of the present invention, the ratio of elements is important to achieve the desired level of grain refinement, i.e., mean grain size of about 100 μm or less. For example, P/Zr is preferably in the range of 0.8 to 250 (Applicant's original disclosure, p. 14, paragraph [0053]). These features are also recited in the claims. It is clear from the above description that specific conditions and environment are necessary to obtain the desired grain size of about 100 μm or less in the copper-based alloy casting of the present invention.

However, Parikh '132 does not teach, or show, the claimed conditions, i.e., the phase structure and the ratio of elements.

For all of the above reasons, the Examiner has failed to establish a <u>prima facie</u> case of obviousness against claims 1, 5, 7-10, 21, 26, 29, 35 and 36 of the above-captioned application.

(b). <u>Unexpected Results Would Rebut Any Prima Facie Case, Even if Made</u>

Even assuming a <u>prima facie</u> showing of obviousness had been made, however, (which is not a valid assumption), the unexpected advantages of the claimed combination would be sufficient to rebut any such showing.

The preferred embodiment of the present invention also features fine grain size of the refined grains of the copper-based alloy casting, i.e., 100 μm or less, and dendrites without arms, generated during melt-solidification of casting process. According to the present specification, grain sizes of metal-based alloy casting via grain refinement are generally much bigger than the claimed grain size, and dendrite having arms are generally shaped in a casting process (Applicant's original disclosure, p. 4, paragraph [0016]).

A typical example of refined grain sizes and dendrite arms is disclosed in ASM Metals Handbook and Ninth edition as attached as Exhibit A (Exhibit A: Metal Handbook Ninth Edition, Volume 9 Metallography and Microstructures, pages 629-631). The document teaches a casting example of aluminum alloy, which is one of the most noted alloys for grain refinement of casting where titanium and boron are added. Fig. 7 and Fig. 9 of the document show grain sizes of about a few to several tens of millimeters and 0.3 mm to 1 mm, respectively, in the aluminum alloy. Fine and coarse dendritic structures of aluminum alloy ingots, in which the dendrite have arms, are illustrated in Fig. 3 and Fig. 4 of the document.

In comparison, Figs. 3 and 4 of the present application show the fine grains as nearly invisible, i.e., mean grain size of about 100 μm or less. Also, as shown in Fig. 10 of the present application, dendrites having no arms in the circular or oval shapes are crystallized and divided in the copper-based alloy casting. These features are surprising and unexpected advantages of the present invention, different from Parikh '132 and any other art relating to the present invention, which are achieved by specific conditions and environment as claimed, i.e., the amount of Zr, the values of the expression, the phase structure composed of α, κ and γ-phases, and the ratio of elements.

(c). No Reasonable Expectation of Success to achieve Applicant's Claimed Invention Even if the Modification of Parikh '132 Were Made

A proper rejection under Section 103 requires showing (1) that a person of ordinary skill in the art would have had a legitimate reason to attempt to make the composition or device, or to carry out the claimed process, and (2) that the person of ordinary skill in the art would have had a reasonable expectation of success in doing so. PharmaStem Therapeutics, Inc. v. ViaCell, Inc., 491 F.3d 1342, 1360 (Fed. Cir. 2007). In this case, the Examiner has failed to demonstrate that a person of ordinary skill in the art would have had a legitimate reason to combine JP '837 and APAA, and a reasonable expectation of success of arriving at Applicant's claimed invention even if the modification was made.

Since Parikh '132 discloses a copper base alloy that may contain more than 10 optional elements, excessive and undue experiments would be required for one having ordinary skill in the art to select adequate elements and portions thereof.

Therefore, a person of ordinary skill in the art would not realize the present invention from the disclosure of Parikh '132 itself and/or modified Parikh '132. Even if Parikh '132 were modified, a person of ordinary skill in the art would not have reasonable expectation of success of arriving at Applicant's claimed invention because, for example, there is no teachings, suggestions, and/or reasons presented by the disclosure of Parikh '132 to obtain a copper-based alloy casting having the specific compositions and conditions claimed in independent claim 1.

For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against the Applicant's claimed invention. In addition, the evidence of unexpected results demonstrates the non-obviousness of the claimed invention.

ii. <u>The Section 103 Rejections against claims 6, 16, 22 and 30 over the combination of Parikh '132 and Nakamura '736</u>

The combination of Parikh '132 and Nakamura '736 fails to establish a <u>prima facie</u> case of obviousness against claims 6, 16, 22 and 30 for the following reasons

(a). <u>Parikh '132</u>

Parikh '132 is discussed above.

As admitted by the Examiner (Office Action, dated October 16, 2009, at p. 4, lines 14-15), Parikh '132 does not teach, or suggest, (i) "the copper-based alloy casting further comprising: at least one element selected from the group consisting of 0.004 to 0.45% of Pb, 0.004 to 0.45% of Bi, 0.03 to 0.45% of Se and 0.01 to 0.45% of Te, by mass" as recited in claims 6 and 16.

In addition, Parikh '132 does not teach, or suggest, (ii) "wherein grains of the copper-based alloy casting are refined during melt-solidification, and mean grain size of the refined grains after the melt-solidification is 100 μm or less, and wherein α, κ and γ-phases of the copper-based alloy casting occupy more than 80% of phase structure of the copper-based alloy casting" as recited in claim 1 on which claims 6, 16, 22 and 30 are all directly or indirectly depend.

(b). <u>Nakamura '736</u>

Nakamura '736 relates to a clad sheet comprising a metal substrate and a metal cladding layer, and a process for producing such a sheet (Nakamura '736, col. 1, lines 5-8). A clad sheet of Nakamura '736 comprises a copper alloy containing at least 55% Cu and at least one optional component, which can be utilized as a metal substrate, and an Al alloy or Ag solder utilized as a metal cladding layer (Nakamura '736, col. 6, lines 36-62).

Nakamura '736 does not teach, or suggest, (i) "a copper-based alloy casting comprising: 69 to 88% of Cu by mass; 2 to 5% of Si by mass; 0.0005 to 0.04% of Zr by mass; 0.01 to 0.25% of P by mass; and a remainder including Zn and inevitable impurities, and the copper-based alloy casting satisfying $60 \leq Cu - 3.5 \times Si - 3 \times P \leq 71$, and having refined grains, wherein grains of the copper-based alloy casting are refined during melt-solidification, and mean grain size of the refined grains after the melt-solidification is 100 μm or less, and wherein α, κ and γ-phases of the copper-based alloy casting occupy more than 80% of phase structure of the copper-based alloy casting" as recited in claim 1 on which claims 6, 16, 22 and 30 are all directly or indirectly depend.

There are no indications and/or teachings provided in Nakamura '736 to produce the copper-based alloy e.g., having the compositions of elements and satisfying the value of the expression, the mean grain size, and the phase structure, as claimed.

(c). Summary of the Arguments

(1). There Is No Prima Facie Case

The combination of Parikh '132 and Nakamura '736 does not teach, or suggest, (i) "wherein grains of the copper-based alloy casting are refined during melt-solidification, and mean grain size of the refined grains after the melt-solidification is 100 μm or less, and wherein α, κ and γ-phases of the copper-based alloy casting occupy more than 80% of phase structure of the copper-based alloy casting" as recited in claim 1 on which claims 6, 16, 22 and 30 are all directly or indirectly depend. For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against claims 6, 16, 22 and 30 of the above-captioned application.

(2). <u>Unexpected Results Would Rebut Any Prima Facie Case, Even if Made</u>

Even assuming a <u>prima facie</u> showing of obviousness had been made, however, (which is not a valid assumption), the unexpected advantages of the claimed combination would be sufficient to rebut any such showing.

The preferred embodiment of the present invention also features fine grain size of the refined grains of the copper-based alloy casting, i.e., 100 μm or less, and dendrites without arms, generated during melt-solidification of casting process. According to the present specification, grain sizes of metal-based alloy casting via grain refinement are generally much bigger than the claimed grain size, and dendrite having arms are generally shaped in a casting process (Applicant's original disclosure, p. 4, paragraph [0016]).

A typical example of refined grain size and dendrite arms is disclosed in ASM Metals Handbook and Ninth edition as attached as Exhibit A (Exhibit A: Metal Handbook Ninth Edition, Volume 9 Metallography and Microstructures, pages 629-631). The document teaches a casting example of aluminum alloy, which is one of the most noted alloys for grain refinement of casting where titanium and boron are added. Fig. 7 and Fig. 9 of the document show grain sizes of about a few to several tens of millimeters and 0.3 mm to 1 mm, respectively, in the aluminum alloy. Fine and coarse dendritic structures of aluminum alloy ingots, in which the dendrite have arms, are illustrated in Fig. 3 and Fig. 4 of the document.

In comparison, Figs. 3 and 4 of the present application show the fine grains as nearly invisible, i.e., mean grain size of about 100 μm or less. Also, as shown in Fig. 10 of the present application, dendrites having no arms in the circular or oval shapes are crystallized and divided in the copper-based alloy casting. These features are surprising and unexpected advantages of the present invention, different from Parikh '132, Nakamura '736, and any other art relating to the present invention, which are achieved by specific conditions and

environment as claimed, i.e., the amount of Zr, the values of the expression, the phase structure composed of α, κ and γ-phases, and the ratio of elements.

(3). <u>No Reasonable Expectation of Success to achieve Applicant's Claimed Invention Even if the Combination of Parikh '132 and Nakamura '736 Were Made</u>

A proper rejection under Section 103 requires showing (1) that a person of ordinary skill in the art would have had a legitimate reason to attempt to make the composition or device, or to carry out the claimed process, and (2) that the person of ordinary skill in the art would have had a reasonable expectation of success in doing so. <u>PharmaStem Therapeutics, Inc. v. ViaCell, Inc.</u>, 491 F.3d 1342, 1360 (Fed. Cir. 2007). In this case, the Examiner has failed to demonstrate that a person of ordinary skill in the art would have had a legitimate reason to combine JP '837 and APAA, and a reasonable expectation of success of arriving at Applicant's claimed invention even if the modification was made.

Both Parikh '132 and Nakamura '736 disclose a copper base alloy that may contain more than 10 optional elements. Because of too much option for selection, excessive and undue experimentation would be required for one having ordinary skill in the art to choose adequate elements and their respective properties.

Therefore, a person of ordinary skill in the art would not realize the present invention from the combination of Parikh '132 and Nakamura '736. Even if the combination were made, a person of ordinary skill in the art would not have reasonable expectation of success of arriving at Applicant's claimed invention because, for example, there is no teachings, suggestions, and/or reasons presented by the combination of Parikh '132 and Nakamura '736 to obtain a copper-based alloy casting having the specific compositions and conditions claimed in independent claim 1.

For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against the Applicant's claimed invention. In addition, the evidence of unexpected results demonstrates the non-obviousness of the claimed invention.

III. CONCLUSION

Claims 5, 6 and 16 comply with 35 U.S.C. § 112.

In view of the above amendment s and arguments, Applicant respectfully asserts that the Examiner has failed to establish a prima facie case of obviousness against Applicant's claimed invention.

For all of the above reasons, claims 1, 5-10, 16, 21, 22, 26, 29, 30, 35 and 36 are in condition for allowance, and a prompt notice of allowance is earnestly solicited.

The below-signed attorney for Applicant welcomes any questions.

Respectfully submitted,

GRIFFIN & SZIPL, P.C.

Joerg-Uwe Szipl
Registration No. 31,799

GRIFFIN & SZIPL, P.C.
Suite PH-1
2300 Ninth Street, South
Arlington, VA 22204

Telephone: (703) 979-5700
Facsimile: (703) 979-7429
Email: GandS@szipl.com
Customer No.: 24203